Scientific Report

8th InterPore UK Chapter Conference in Porous Media

Loughborough University, Loughborough, 1–2 September 2025

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Chair, InterPore UK Chapter

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Introduction

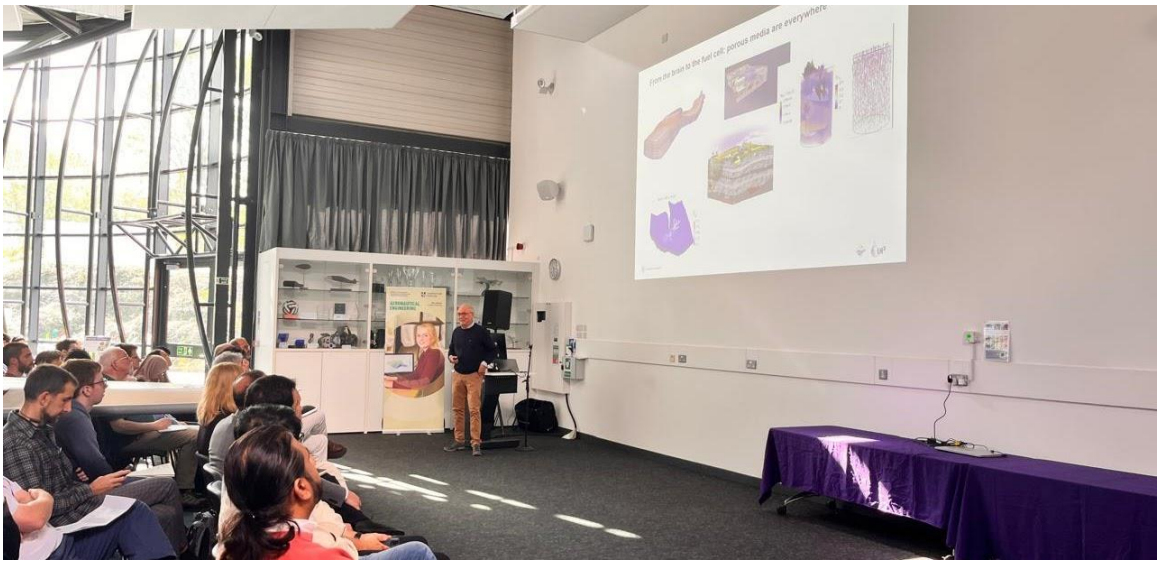
The 8th InterPore UK Chapter Conference in Porous Media, held at Loughborough University between the 1st and 2nd of September 2025, brought together researchers, industry experts, and students to discuss recent advances in porous media research. The event was chaired by Dr Diganta Bhusan Das, who opened the conference with a warm welcome, followed by greetings from Professor Dan Parsons, Pro-Vice Chancellor for Research and Innovation at Loughborough University, and Professor Moataz Attallah, the Dean of the School of Aeronautical, Automotive, Chemical and Materials Engineering (AACME) at the University. More than sixty-five participants were registered, representing a wide cross-section of the UK porous media community, with additional contributions from international colleagues in Germany, Ireland, and India.

The meeting combined high-level distinguished lectures, invited talks, oral communications, flash presentations, and poster sessions. Across eight thematic sessions, the conference showcased the

diverse applications of porous media in environmental engineering, energy systems, healthcare, and advanced manufacturing, while also providing early-career researchers with a platform to present their emerging work.

Session 1 - Opening Lecture

The scientific programme began with the **Kimberly-Clarke Distinguished Lecture** delivered by Professor Rainer Helmig of Stuttgart University. His lecture, titled *"From the Brain to Water Uptake of Roots to Fuel Cells: Porous Media are 'Almost' Everywhere,"* set the tone for the meeting by illustrating how porous media permeate nearly every domain of science and engineering. By bridging topics as diverse as neurological systems, plant water uptake, and fuel cell efficiency, Professor Helmig demonstrated the universality of porous structures and processes, offering a conceptual framework and concepts that resonated throughout the following sessions.



Session 2 - Porous Media in Environmental and Water Engineering

This scientific session focused on environmental and water-related challenges. Professor Jan Hofman from the University of Bath delivered an invited lecture on PFAS degradation during the thermal reactivation of granular activated carbon, a pressing issue in modern water treatment. This was followed by a sequence of oral contributions, including Dr Zhentao Wu's work on structured microchannel substrates for catalysis and separation, Dr Matteo Icardi's multiscale modelling of reverse osmosis membranes, and Dr Mark Leaper's presentation on biochar applications for metal ion recovery. The theme of biochar continued with Ms Fatemeh Khodaparastan's study of oxygen dynamics in smouldering combustion, which linked reaction kinetics to char production. Computational approaches to sorption–desorption under rainfall conditions were discussed by Mr Hamid Moghimi, while Dr Tarek Rashwan introduced applied smouldering as a novel treatment pathway for PFAS in sewage sludge. Mr Pavel Kazakovtsev presented a pore-scale study of nanotechnology in groundwater remediation and Dr Basmah Bushra concluded with a flash presentation on heavy metal bioaccumulation in aquatic ecosystems. Taken together, this session illustrated the critical role of porous media in safeguarding environmental and water resources, combining laboratory insights, computational models, and applied technologies.

Session 3 - Multiscale Flow, Transport and Reactivity in Porous Media – Part I

The second major theme of the conference addressed multiscale flow and reactive processes. Dr Simon Gregory introduced a microbial limits database for safe geological storage. This was followed by an invited lecture by Professor Dan Parsons, who shifted attention to coastal systems by exploring how substrate structure and pore-space dynamics shape estuarine morphodynamics. Other contributions

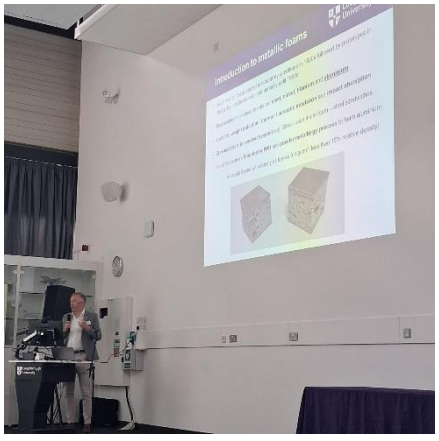
included Dr Buddha Deka Boruah's discussion of porous microscale current collectors for on-chip energy storage, and investigations into hydrogen storage efficiency and economics by Mr Abdolali Mosallanezhad and Mr Harri Williams. Ms Samantha Marchbank discussed mixing processes during underground storage of hydrogen. Ms Saeid Telvari concluded this block by extending modelling techniques for three-phase CO_2–CH_4–brine systems. The mixture of subsurface carbon storage, coastal morphodynamics, and emerging energy storage materials highlighted the multiscale nature of porous media challenges.

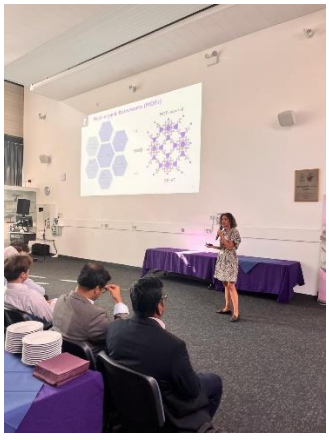
Session 4 - Porous Media in Health Care

One of the most dynamic sessions was devoted to health care applications of porous media. The invited presentation by Dr Conor O'Mahony of the Tyndall National Institute, Ireland, focused on minimally invasive transdermal delivery and diagnostics, setting the stage for a suite of contributions on microneedle technologies. Dr Qonita Kurnia Anjani and Dr Abraham M. Abraham, both from Queen's University Belfast, examined microarray patch safety and smart microneedle injectors, respectively. Complementary computational approaches were introduced by Ms. Pangkhi Medhi, who used molecular dynamics for dissolving microneedle design, and by several Loughborough researchers, including Mr Sarjeel Rashid, Dr Ravi Prakash, and Dr Rahul Nadda, who presented biomechanical and computational models for hollow microneedles. Dr Huanhuan Li concluded the session with her work on hydrogel-forming microneedles for drug delivery. This session, with its combination of experimental development and computational modelling, demonstrated the rapid growth of porous media applications in biomedical engineering.

Session 5 - Manufacturing and Advanced Applications

The second day opened with a focus on manufacturing technologies for porous media. Professor Moataz Attallah outlined advances in 3D printing of metallic lattices, while Professor Begum Tokay presented on inkjet printing of composite membranes. Industrial perspectives were provided by Mr Andrew Jones of Promethean Particles, who discussed scale-up of metal-organic frameworks for carbon capture, and by Dr Finian McCann of Loughborough University, who studied aluminium foams under dynamic conditions. This sequence of talks highlighted how research on porous media is increasingly connected to industrial practice, where issues of scalability and robustness are crucial.



Session 6 – Applications of Particles and Porous Media in Various Applications

Various applications of porous media beyond manufacturing were highlighted in a set of flash talks. Contributions included online presentations from Ms Aarti Puri and Ms Dharna Bhardwaj of the Indian Institute of Technology Roorkee on electrochemical water treatment and nanocellulose synthesis, as well as work from UK-based researchers Drs Nilanjan Mukherjee, Waleed Dokhon, Monojit Mondal, on polymer particle simulations, underground hydrogen imbibition, and activated carbon electrodes.

These rapid presentations created a high-density overview of ongoing exploratory research, much of it focused on sustainability and renewable applications.

Session 7 - Energy and Net Zero Applications

The Net Zero and energy session returned to issues of climate and energy transition. Mr Briggs Ogunedo of Cranfield University discussed the molecular role of water in aminosilane grafting for carbon capture, while Dr Kazeem Rabiu explored the use of low-cost electrical sensors to monitor CO_2 sequestration. Ms Esther Odiki used micro-CT imaging to compare pore structures in algae-derived biochar, and Dr Nibagani Naresh presented porous gold-PANI microelectrodes for supercapacitors. This mix of capture, monitoring, material characterization, and electrochemical device development provided a clear picture of porous media as an enabling science for decarbonization pathways.

Session 8 - Multiscale Flow, Transport and Reactivity in Porous Media - II

The final technical session returned to multiscale modelling and natural systems. Professor Graham Sander offered a fully analytical solution to the Richards equation, while Dr Jagannath Biswakarma presented case studies of arsenic contamination in Assam, India. The biological complexity of porous systems was highlighted by Dr Sajjad Foroughi, who studied termite nests with micro-CT, and Mr Petr Nikolaev, who investigated capillary heterogeneity in CO_2-brine flows. Dr Marco Discacciati presented modelling of incompressible fluids at porous interfaces, while contributions from Adetomiwa Aderemi and Nihal Muhammed Habeeb considered geothermal flow systems and salt precipitation in drying, respectively. The session also included presentations on Dr Mykyta Chubynsky's computational method for two-phase flow in fractures and Joshua Finn's viscoporoelastic modelling of peatland development. The breadth of topics captured both the complexity of natural porous systems and the advances in modelling that allow them to be interrogated

Flash and Poster presentations; Networking Sessions

All oral and poster presentation sessions were integrated into breaks and receptions, ensuring strong interaction between participants. More than twenty posters were presented at the conference, many by PhD students and early-career researchers. Flash talks, numbering over a dozen, provided short, intense presentations that complemented the longer and shorter oral sessions. These contributions strengthened networking opportunities and broadened exposure to many emerging ideas.

Conclusions

The 8th InterPore UK Chapter Conference demonstrated the multidisciplinary reach of porous media science. From water treatment and environmental remediation to biomedical engineering, from additive manufacturing to carbon sequestration and supercapacitors, the presentations showcased how porous media underpin solutions to some of the most pressing global challenges. The Kimberly-Clarke Distinguished Lecture provided a unifying vision of porous media science. At the same time, the invited lectures and oral contributions reflected the UK's strong role in this research field.

The conference also achieved a balance between fundamental modelling, experimental development, and industrial translation. Early-career researcher participation was particularly strong, ensuring the future vitality of the field. As such, the meeting not only summarised current progress but also outlined the directions in which porous media research in the UK is heading, particularly in the context of sustainability, net-zero targets, and health care innovation.

The conference closed with remarks by Dr Diganta B Das, who emphasised the importance of ongoing participation in the UK InterPore Chapter activities and invited attendees to become further involved in the growing community.